PATENT

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Applicant: Lewis	Examiner: Doerrler, W.C.
Serial No.: 10/608,733	Group Art Unit: 3744
Filed: June 30, 2003	Docket: BSA 03-09
For: ENHANCED MAGNETOCALORIC EFFECT MATERIAL	Dated: October 28, 2004

Commissioner for Patents
PO Box 1450
Alexandria, Virginia 22313-1450

DECLARATION UNDER 37 C.F.R. §1.132

Sir:

I, Laura J. Henderson Lewis, Ph.D., 53 Oak Drive, Calverton, New York, declare as follows:

1. I am an expert in the field of Material Sciences as evidenced by my resume, which is attached as Exhibit A. Additionally, I am the inventor of the above-identified patent application.

2. My invention, as claimed in the above-identified patent application, is concerned with a method to control the magnetic phase transition, and hence the magnetocaloric effect (MCE), in materials that undergo a magnetostructural transition.

3. U.S. Patent No. 4,985,072 to Sahashi et al. ("the Sahashi patent") describes a combination of micron-sized magnetocalorically-active RAl_2 (R = rare-earth element) Laves-type intermetallic powders of different phase character, and hence different magnetic transition properties, connected by a metallic magnetic phase included for thermal conduction only. The RAl_2 family of compounds exhibit a thermodynamically second-order standard magnetic phase transition at the Curie point, but generally do not exhibit volume changes upon application of a magnetic field.

4. U.S. Patent No. 5,743,095 to Gschneidner, Jr. et al. ("the Gschneidner patent") reveals the discovery of a new family of so-called "giant" magnetocaloric materials that show a very large temperature change under the influence of an applied magnetic field by virtue of the large entropy change attendant to its *simultaneous* magnetic and structural ("magnetostructural") phase transition. The magnetostructural transition is of thermodynamic first-order, fundamentally different from the second-order magnetic transition seen in the RAl_2 compounds described in the Sahashi patent and related compounds that have only a negligible structural change, if any, at their magnetic transition temperature. Accordingly, since the teachings of the Sahashi patent fundamentally differ from the teachings of the Gschneidner patent, there would be no motivation to combine these patents.

5. In any event, my invention is directed to a method to control and tune the magnetic phase transition, and thus the MCE, by restricting volume changes (i.e., by the application of strain). Neither the Sahashi patent nor the Gschneidner patent describe control of the magnetic phase transition, and thus the MCE, by restricting volume changes. Instead, both the Sahashi and Gschneidner patents propose the standard approach in materials science of compositional variation as a method to tune the magnetic transition.

6. I hereby declare that all statements made herein of my own knowledge are true, and that all statements made on information and belief are believed to be true. Further that these statements were made with the knowledge that willfully false statements, and the like, so made are punishable by fine or imprisonment or both under Section 1001 of Title 18 of the United States Code, and that such willfully false statements may jeopardize the validity of the application of any patent issued thereon.

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SUMMARY: Materials Science of permanent magnets, magnetic and optical recording materials, magnetocaloric systems, oxide/chalcogenide electronic materials systems and rapidly-solidified materials. Extensive collaborative and organizational experience coupled with managerial experience. Strong industry interaction and international experience.

EDUCATION:

THE UNIVERSITY OF TEXAS *Austin, Texas*
Ph.D., Materials Science and Engineering, August 1993. Research Supervisor: J.B. Goodenough.
Dissertation title: "The Crystal Chemistry and Role of Metal-Metal Bonding in the Monochalcogenides TiS, VS, TiSe, VSe and Their Solid Solutions"

MASSACHUSETTS INSTITUTE OF TECHNOLOGY *Cambridge, Mass.*
M.S., Electronic Materials, August 1988. Research Supervisors: R. C. O'Handley, B. L. Averbach
Thesis title: "Magnetic Properties of Rapidly-Solidified Metallic and Ceramic Alloys"

UNIVERSITY OF CALIFORNIA *San Diego, Calif.*
B.A., Physics with Specialization in Earth Sciences; February 1985

PROFESSIONAL EXPERIENCE:

Brookhaven National Laboratory, *Upton, New York*
Materials Science Department, Energy Sciences and Technology Department

Scientist:	Oct. 1999 - present
Associate Scientist	Oct. 1997 – Sept. 1999
Assistant Scientist	Oct. 1995 - Sept. 1997
Postdoctoral Researcher	Sept. 1993 - Sept. 1995

Research Program: Structure-Sensitive Properties of Advanced Permanent Magnet Materials; Fundamentals of Magnetic Nanomaterials: Investigations of relationships between crystal lattice defects, nanostructure, and the magnetic properties of advanced permanent magnetic materials and related amorphous/nanocrystalline precursors. Focus on functional properties of magnetic materials. Application of rapid solidification processing methods to novel magnetic materials. Duties include supervision of undergraduate and graduate students, post-doctoral researchers and technicians; equipment maintenance and coordination.

Recent Professional Highlights, Activities

- *Executive Committee*, American Physical Soc. Topical Gp on Magnetism (GMAG); term ends 2006.
- *International AdCom*, IEEE Magnetics Society; term expires 2006.
- Scientific Theme Leader "Magnetic Nanoassemblies" and Scientific Outreach Coordinator, Brookhaven Center for Functional Nanomaterials (www.cfn.bnl.gov)
- Core participant, organizer and group representative in the DOE-sponsored programs of distributed Center of Excellence in Synthesis and Processing of Advanced Materials: *Tailored Microstructures in Hard Magnets* and *Isolated and Collective Phenomena in Nanocomposite Magnets*.
- Adjunct Prof., Dept. of Materials Science and Engineering, State University of New York, Stony Brook (2000-present); Visiting Prof., Dept. of Chemistry, SUNY Stony Brook (Spring, 1999).
- International Advisory Committee, International Training Centre for Materials Science (ITIMS), Hanoi, Vietnam (2000); XVII Workshop on Rare Earth Magnets (Delaware, 2002); International Program Committee, 18th International Conference on High-Performance Magnets and their Applications (Annecy, France, Sept. 2004); Program Chair, Intermag 2003 (http://www.intermagconference.com/); Workshop Chair, "Workshop on Nanomagnetism using X-Ray Techniques" (Aug 29-Sept 1, 2004, Lake Geneva, WI); Principal symposium organizer: "Hard Magnets: Principles, Materials, Processing", Materials Research Society (MRS) Spring Meeting, April, 1999.

Selected Research Highlights:

- Detailed novel methods to evaluate crystallographic texture in bulk nanocrystalline $Nd_2Fe_{14}B$ magnets; investigations into properties of "exchange-spring" nanocomposite magnets (collaboration with Magnequench International Inc., Anderson, Indiana; Research Triangle Park, NC).

- Elucidated effects of alloying additions on the solidification and magnetic properties of $Nd_2Fe_{14}B$; modeling of hysteresis loops; properties of "bulk glassy alloys" (collaboration with Ames Laboratory, Iowa State University; Idaho National Environmental and Engineering Laboratory).

- Identified coupling mechanisms in magnetic materials for high-temperature magnetic applications; Elucidation of coercivity/ordering and exchange spring phenomena in $L1_0$-type CoPt, FePt thin films (collaboration with Carnegie Mellon University, Lehigh University).

Patents

- United States Patent # 5,030,332 (July, 1991) Henderson *et al.* "Method for Making Magnetic Oxide Precipitates"; "Simple Magnetic Field Amplification for Functional Magnetic Materials" (in review)

Selected Invited Presentations:

- Workshop on Interplay of Magnetism and Structure in Functional Materials; Benasque (Spain) 9th - 14th February 2004. Keynote speaker: "*Manipulation of the Metamagnetic Transition and Entropy Change in $Gd_5(Si,Ge)_4$*".

- "*Manipulations of the First-Order Magnetic Phase Transition in Functional Magnetic Materials*", The Istituto Elettrotecnico Nazionale Galileo Ferraris (IEN), Torino, Italy. February 2004.

- Materials Science Department, Argonne National Laboratory, "*The Stressful World of Magnetic Nanocomposites*"; Feb. 02

- Columbia University, Joint Materials Center (MRSEC) and Materials Science and Engineering Dept. Seminar, October 2001, "*From Anarchy to Oligarchy: Structure-Magnetism Connections in Magnetic NanoSystems*"

- "*Solidification and Nanostructure in Rapidly-Solidified $Nd_2Fe_{14}B$*", Institute of Materials Congress 2000, Cirencester, Gloucestershire, UK., 12-14 April 2000.

- "*Stress, Strain and Implications in Permanent Magnetic Nanocomposites*", Dept. of Physics, Trinity College, Dublin, Ireland, 10 April 2000.

- "*Rapidly-Solidified Permanent Magnetic Materials: Factors Affecting Quenchability and Magnetic Properties in $Nd_2Fe_{14}B$*", Plenary talk, 3rd International Workshop on Materials Science, Hanoi, Vietnam, Nov. 2-4, 1999.

Supplemental Research Interests: Non-equilibrium nanoscale systems and synthesis; Functional nanomaterials; Magnetic properties and processing oxide compounds; RE-M_5 Battery Materials; GMR and magnetoresistive effects in granular materials, oxides; Phase transitions in transition-metal chalcogenides and pnictides; Itinerant/localized electronic interactions and transitions; Magnetic and optical recording materials.

Experimental Techniques: Inorganic compound synthesis, x-ray diffraction (including x-ray diffraction at the National Synchrotron Light Source (BNL) and the Advanced Photon Source (ANL)), thermal analyses techniques, *ac* & *dc* SQUID magnetometry, vibrating sample magnetometry, transport measurements, pycnometry, analytical electron microscopy, atomic and magnetic force microscopy; x-ray photoelectron and Auger spectroscopies, various rapid solidification techniques.

OTHER:

- *English Instructor:* Huang He (Yellow River) University, Zhengzhou City, Henan, P.R.China. Designed and implemented an oral and written language program for Chinese factory workers. Duties included negotiations with government officials at all levels. Possess good working knowledge of Mandarin Chinese, both written and spoken.

—Publications upon request—